Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss several key issues affecting DOE's program to develop new technologies for environmental cleanup. DOE established the technology development program in 1989 in its Office of Environmental Management (EM). EM's Office of Science and Technology has articulated the mission of the technology development program as developing new technologies to reduce cleanup costs, reduce risks, and do what cannot be done with conventional methods. About $2 billion has been spent on this mission, but the program has experienced management problems and its success in implementing innovative technologies has been limited.

Today we will discuss (1) EM's progress in resolving management problems identified in reports we have issued since 1992, (2) barriers to the use of innovative technologies, (3) the Technology Deployment Initiative that EM has proposed to address these barriers, (4) the program's methods for computing cost savings from the use of innovative technologies, and (5) future challenges facing the technology development program.

In summary, we found the following:

- In our April 1992 report, we found that the program was not well managed and that EM's focus was on setting up the program, not on its future management.[1] In particular, we found that EM had not established key management tools, such as cost estimates and schedules, and decision points for evaluating technology development projects. In

[1] Cleanup Technology: Better Management for DOE's Technology Development Program (GAO/RCED-92-145, Apr. 10, 1992).

January 1994, EM implemented a management plan for the program that incorporated our recommendations.

- In our August 1994 report, we identified several barriers to the use of innovative technologies, including the fact that DOE site officials may not be familiar with innovative technologies and fear that using new technologies may lead DOE to miss milestones if the technology fails to perform as expected.[2] In response to our recommendations, the Office of Science and Technology took several steps, including establishing site technology coordination groups to improve two-way communication on sites' technology needs and the capabilities of newly developed technologies. However, barriers to the use of innovative technologies still exist, such as DOE's reliance on site contractors for technical decisions and the possibility that contractors may favor particular technologies based on their own experiences and investments.

- EM's fiscal year 1998 budget request proposes a $50 million initiative--called the Technology Deployment Initiative--that would provide additional funding to sites that first deploy an innovative technology. While the Office of Science and Technology hopes that this will increase the use of innovative technologies, several unresolved issues remain, such as whether additional sites beyond the first site will use the innovative technology.

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[2]Department of Energy: Management Changes Needed to Expand Use of Innovative Cleanup Technologies (GAO/RCED-94-205, Aug. 10, 1994).

- The Office of Science and Technology has identified potential savings ranging from $476 -$490 million from the use of innovative technologies. At your request, in order to assist the Subcommittee with this hearing, we conducted a limited review of the methods used to estimate the cost savings for five cases that account for nearly half of the estimated cost savings. Overall, we found that DOE used reasonable methods to estimate the cost savings associated with the five projects.

- Based on our prior work on the Environmental Management and technology development programs, we believe that there are several new challenges facing the Office of Science and Technology. EM's initiatives to accelerate cleanup and privatize certain projects will affect the program because cleanup technologies now must be brought to fruition in time to be of use in a shortened 10-year time frame, rather than the 30 or more years originally planned.

PAST MANAGEMENT PROBLEMS

EM's technology development program has experienced management problems since its inception in 1989. In April 1992, we reported that the program was not well managed and that EM's focus was on setting up the program, not on its future management. In particular, we found that EM had not established overall cost estimates and schedules, decision points for evaluating technology development projects, or measurable performance goals. Without these critical management tools, we believed EM would have difficulty weeding out poorly performing projects and measuring the program's progress towards its goals. We recommended that EM develop and put in place these key management tools.

In January 1994, EM implemented a management plan for the program that incorporated our recommendations. The technology development program established cost estimates and schedules for projects that are tracked in EM's automated system. EM also developed decision points (called gates) and related data requirements, which are used to evaluate projects and make "go/no-go" decisions. While EM has established performance goals such as readying technologies for deployment, it had not, until requested to do so by this Subcommittee, measured its performance against a goal of actual use of technologies. For example, it had not attempted to develop a comprehensive list of the technologies it had deployed and the associated cost savings. Consequently, it has been difficult to determine the program's degree of success in implementing new technologies and reducing cleanup costs.

In July 1996, we reported that EM had not coordinated its technology development activities so that it could prevent unnecessary duplication of effort.[3] Specifically, we found that technology development was being conducted not only by the Office of Science and Technology but also by EM's program offices, in particular, the Office of Waste Management, which are responsible for the actual cleanup. For example, we identified melter technologies, which use heat to treat hazardous and radioactive wastes, as an area of potential duplication, because several DOE offices were funding approximately 60 projects whose estimated costs in 1996 were $40 million. A key reason we found for this potential problem was that EM lacked a comprehensive list of technology development projects being carried out by its various program areas.

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[3]Energy Management: Technology Development Program Taking Action to Address Problems (GAO/RCED-96-184, July 9, 1996).

Progress has been made in this area. Specifically, according to an official in the Office of Waste Management, the office expects to complete a comprehensive list of its technology development projects in May 1997. The Office of Science and Technology already has such a list. Moreover, communication between the Office of Waste Management and the Office of Science and Technology has improved due to the establishment of interoffice groups to focus technology development on specific priority areas. Additionally, the number of melter projects under development has been reduced from the number cited in our July 1996 report. EM is funding only five melter development projects in fiscal year 1997 at a total cost of approximately $12 million as compared with 60 melter projects at a cost of $40 million in 1996.

Our 1996 report also found that technology development projects had become more concentrated at certain field sites that EM had designated to lead specific technology development areas, known as focus areas. For instance, EM designated its Hanford site in Washington State to lead the development of technologies for remediating radioactive waste in tanks, the Idaho Falls Office to lead the development of technologies for mixed waste,[4] and the Savannah River site in South Carolina to lead the development of technologies for soil and groundwater remediation. We found that in fiscal year 1996, each lead site received more dollars for projects in its area than it had received in fiscal year 1995, before the restructuring. For example, Savannah River received 28.6 percent of the funding for technology development projects for soil and groundwater remediation in fiscal year 1996, up from 10.9 percent in fiscal year

[4]Mixed waste is contaminated by both hazardous and radioactive material.

1995.[5] This concentration of funding at lead sites led to concerns by non-lead site researchers that their projects were not being fairly evaluated in the selection process.

In looking at the fiscal year 1997 funding for projects at the various sites, we found that the concentration of funding for projects at the lead sites had lessened at two of the three sites.[6] For example, Idaho's share of the funding for mixed waste projects fell from 49 percent in fiscal year 1996 to about 39 percent in fiscal year 1997. Savannah River's share of the funding for work on technologies for soil and groundwater contamination in fiscal year 1997 is 19.4 percent, substantially lower than the site's 28.6 percent share in fiscal year 1996. Hanford's share of the funding for work on tank waste technologies increased slightly in fiscal year 1997, by about 6 percent. Table 1 lists the funding shares over the 3-year period.

[5]In fiscal years 1995 and 1996, Savannah River led the development of technologies for groundwater and soil/landfills. These areas are now combined in the subsurface contaminants area. We have combined the funding amounts for the two areas for fiscal years 1995 and 1996 in order to provide a comparison with the funding for the subsurface area in fiscal year 1997.

[6]We excluded Morgantown, the lead site for technologies for the decontamination and decommissioning of facilities, because Morgantown does not perform any technology development projects at its own location. We also excluded the area for developing technologies to stabilize and immobilize plutonium because its activities were still in the planning stages at the time of our 1996 review.

Table 1: Percentage of Total Funding for Focus Areas Received by Lead Sites

Lead site (focus area)	Fiscal year 1995[a]	Fiscal year 1996[b]	Fiscal Year 1997
Richland, Washington (tanks)	51.3	51.8	57.6
Idaho Falls, Idaho (mixed waste)	45.6	49.0	39.0
Savannah River, South Carolina (subsurface contaminants)	10.9	28.6	19.4

[a]Before restructuring

[b]First year of restructuring

We also found that none of the lead sites were using disinterested reviewers to determine the technical merit of the proposed work. However, EM has since implemented an independent peer review process in conjunction with the American Society of Mechanical Engineers. Under the society's peer review process, reviews are performed by a panel having no personal stake in the outcome of the review. Independent peer reviews are required before technologies can move into pilot-scale projects or field testing and are strongly recommended before making the decision to move projects from the idea-generation phase to the proof-of-technology phase of development.[7]

[7]The Office of Science and Technology uses a five-step process for developing technologies, starting with idea generation, progressing through proof of technology to engineering development and demonstration, and culminating

BARRIERS TO THE USE OF INNOVATIVE TECHNOLOGIES

As we and others have previously reported, innovative technologies have been used infrequently in DOE's cleanup activities. Instead, agency officials have tended to choose conventional approaches. In our August 1994 report, we identified several causes for this reluctance to adopt new technologies.

- DOE site officials fear that using new technologies may lead DOE to miss milestones if the technology fails to perform as expected.

- DOE's stakeholders have conflicting priorities that sometimes work against the approval of innovative approaches. For instance, an innovative approach that speeds cleanup may be seen by local governments as a threat to local jobs and economies.

- DOE site officials may not be familiar with innovative technologies. They may believe that their use would present an unacceptable risk or be unacceptable to regulators. Lack of reliable information could contribute to this problem.

- DOE officials often rely on recommendations from site contractors who may favor particular technologies on the basis of their own experiences and investments.

To help increase familiarity with and consideration of innovative technologies,

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with implementation or utilization by end users.

we recommended that EM (1) formally include staff from the Office of Science and Technology in evaluating and selecting technologies to be used in cleaning up sites and (2) more fully involve regulators and other stakeholders in decisions about technology selection.

In response to our recommendations and a general concern about the barriers to the use of innovative technologies, the Office of Science and Technology has taken a number of steps, including the following:

- It reorganized the program into specific areas to focus on the most pressing technology needs and increase the involvement of EM's program offices in technology development. EM has established these areas to develop technologies for remediation of radioactive wastes in tanks, soil and groundwater remediation, mixed waste problems, decontamination and decommissioning of facilities, and plutonium stabilization and storage. Teams for these areas include members from sites and from headquarters program offices, such as the Office of Waste Management.

- It established site technology coordination groups to improve two-way communication on sites' technology needs and the capabilities of newly developed technologies.

- It is working with stakeholder organizations and state regulators to facilitate the permitting of new technologies in multiple states.

NEW INITIATIVE TO INCREASE USE OF INNOVATIVE TECHNOLOGIES

Recognizing that barriers to the use of innovative technologies still exist, EM has proposed $50 million for a Technology Deployment Initiative in its fiscal year 1998 budget request. This initiative would provide funding to DOE's sites for the first deployment (use) of an innovative technology that has already been tested and demonstrated. EM is particularly interested in increasing the use of innovative technologies that could speed cleanup or reduce costs. Proposals from the sites for this new program are due in May 1997. In selecting proposals, EM plans to consider factors such as: the improvement over the baseline technology, involvement of more than one DOE location, acceleration of cleanup, approach to stakeholder and regulatory considerations, and cost reduction. If cost savings are achieved through the use of an innovative technology, EM plans to allow the first site that deploys the technology to retain the savings to accelerate other cleanup projects.

We recently reviewed the Technology Deployment Initiative as part of our annual review of EM's budget and have several concerns.[8] Under this approach, DOE's sites would receive additional funds to select the best technology for the job. However, it is not clear to us that providing additional funding through the Office of Science and Technology, a program that is responsible for the design and testing of technology, is the best way to accomplish the use of innovative technologies. Nor does it appear that EM has studied alternative means of accomplishing this goal through its program offices, such as the Offices of Environmental Restoration and Waste

[8]We plan to report on this in August 1997.

Management.

EM did not arrive at its $50 million budget request through a detailed study. According to managers in the Office of Science and Technology, the amount of funding requested was judgmental and was intended to provide for a variety of projects in several geographic areas. However, the number of projects that would be funded is also uncertain. Some officials estimated that 8 to 15 projects could be funded, while another official estimated that 20 or more could be funded.

It is uncertain that additional sites beyond the first deployment would subsequently use the innovative technologies. While the site making the proposal under the Technology Deployment Initiative must make a written commitment to use the innovative technology, additional sites are required to submit only letters of interest with the proposal.

Finally, while the Technology Deployment Initiative attempts to overcome some of the barriers to using newer technologies, other barriers remain, making the success of the initiative uncertain. For instance, one barrier has been the concern about regulators' willingness to accept new technologies. The requirement that proposals under the initiative develop an approach to deal with regulators may help to reduce this barrier. However, the initiative does not address DOE's reliance on site contractors for technical decisions and the possibility that contractors may favor particular technologies on the basis of their own experience or investments. In discussing with us the difficulties in getting sites to use newer technologies, the Deputy Assistant Secretary for Science and Technology described the initiative as working within the existing reality of the Environmental Management program. Specifically, EM's traditional contracting

approach does not provide incentives for speedier, more cost-effective cleanups. This significant barrier may not be overcome until EM's ongoing contract reforms are more fully implemented.

COST SAVINGS FROM INNOVATIVE TECHNOLOGIES

In response to this Subcommittee, the Office of Science and Technology supplied a list of innovative technologies that had been deployed or selected for use and the associated cost savings. The Office estimated that the use of 41 innovative technologies would result in cost savings ranging from $476 million to $490 million; cost savings from other innovative technologies have yet to be determined. As agreed, we conducted a limited review of the methods the Office of Science and Technology used to derive cost savings for five technology deployment projects that accounted for almost 50 percent of the estimated cost savings. Table 2 describes the five projects, the estimated cost savings, and the current status of the projects.

Table 2: Description of Five Innovative Technologies With Cost Savings Estimates

Dollars in millions

Name of technology (location of use)	Description	Cost savings estimate	Status of technology
Deep Soil Mixing (Portsmouth)	Adaptation of technology from heavy construction industry. Use of a hollow drilling tool and chemicals along with vapor stripping to remediate contaminants in soil and groundwater.	$75.0	Remediation project completed in 1994.
SVS Automated Control System (Savannah River)	Automated controls adapted from oil industry for use on soil vapor extraction units in remediating underground contamination.	$9.4	Automated controls installed in August 1996, to be used for duration of project--about 20 years.
Dynamic Underground Stripping (Lawrence Livermore National Laboratory)	Combination of technologies of steam injection and vacuum extraction, electrical resistance heating, and underground imaging and monitoring to extract underground contamination.	$19.0	Cleanup of gasoline spill completed in December 1993.
In Situ Solution Mining for Uranium Recovery from Groundwater Plumes (Fernald)	Adaptation of technology from mining industry to use injection wells to extract uranium from groundwater.	$100 .0	Field demonstration currently under construction and expected to begin operating in spring 1998. Full-scale deployment in subsequent phase.

Name of technology (location of use)	Description	Cost savings estimate	Status of technology
Minimum Additive Waste Stabilization/ DuraMelter (Savannah River)	Vitrification (immobilization in glass) of mixed waste in M-Area tanks.	$25.0	Melter began operating in October 1996 but is currently off-line because its interior deteriorated. DOE expects to re-start melter by the end of 1997.

Overall, we found that DOE used reasonable methods to estimate the cost savings associated with the five projects. However, the degree of confidence that can be placed in the estimates varies.

For three projects--Deep Soil Mixing, SVS Automated Control System, and Dynamic Underground Stripping--the methods used to prepare the estimates appear reasonable. For example, for the SVS Automated Control System project, DOE used the actual cost and productivity savings incurred since the technology was deployed as the basis for estimating the reduced time and resulting cost savings associated with using this new automated control system as compared with using the previous manual control system for the remainder of the cleanup effort. Similar approaches were used for estimating the savings associated with the other two projects. However, DOE was not able to supply the original supporting documentation for the baseline used to compute the savings for the Deep Soil Mixing project. In response to our requests, DOE was able to produce a newer baseline estimate that resulted in a cost savings estimate of $81 million.

For the In Situ Uranium Recovery project, we found that although the basic methodology used to estimate the savings appeared reasonable, the project is at such an early stage, that its estimate can best be described as very preliminary. Specifically, this project is currently under construction; a demonstration phase is scheduled to begin in 1998 before full scale operation. DOE officials described the cost savings from this project as "conceptual estimates" that could change depending on how much the project costs to run and how long it operates. If the project costs more to operate than DOE currently expects, or needs to operate longer than the 7.5 years currently planned, the cost savings could be significantly lower.

Finally, we have concerns about the savings estimate for the Savannah River DuraMelter. In addition to attributing the savings from this project to technology development, DOE has also claimed the same savings under its privatization initiative. In our recent report on the cost savings estimates for DOE's privatization projects,[9] we noted that the accuracy of the estimate associated with this project was affected by the fact that the savings were derived by comparing projects of different scopes. Specifically, DOE compared the cost of having the management and operating contractor build a permanent facility that would use grout (a cementlike material) to immobilize the existing waste in the M-Area tanks plus additional waste that was expected to be generated in support of continuing reactor operations over a 10-year period with the cost of having the privatized contractor build a temporary facility and vitrify only the existing inventory. No data existed to make a one-for-one cost comparison of projects with similar scopes. When we discussed the status of this project with the DOE project manager, he told us that the use of a different technology--

[9]Nuclear Waste: DOE's Estimates of Potential Savings From Privatizing Cleanup Projects (GAO/RCED-97-49R, Jan. 31, 1997)

vitrification versus grout--accounts for only about $6 million of the claimed savings. The balance is due to changes in the scope and duration of the project.

NEW ISSUES FACING THE OFFICE OF SCIENCE AND TECHNOLOGY

Based on our prior work on the Environmental Management and technology development programs, we believe that there are several new challenges facing the Office of Science and Technology. EM is preparing to embark on a 10-year plan, which is intended to bring all but the most recalcitrant cleanup problems under control within the next 10 years. Previously, the cleanup was expected to last 30 or more years. The proposed 10-year effort raises significant questions for the Office of Science and Technology:

- First, what technologies still under development can be brought to fruition in time to be of use in the shortened 10-year time frame? Officials in the Office of Science and Technology told us that projects in the early stages of development would generally not be funded in fiscal year 1998. In addition, this office is currently reviewing how its projects link to the technology needs and schedules in sites' draft 10-year plans. According to the program manager working on the Office of Science and Technology's input into the 10-year plans, the information from this review may further affect the fiscal year 1998 plans for technology development projects and, by fiscal year 1999, all technology development projects that receive funding should have a clear link to sites' needs under the 10-year plans.

- Second, the Office of Science and Technology is spending about $50 million a year for basic science research. Are some areas of basic research capable of coming to fruition within the 10-year time frame? Or, should the basic science research program focus on the problems that will remain after 10 years?

EM is also relying on the privatization of cleanup activities to help it meet the 10-year time frame. Under privatization, private companies would finance, design, build, and operate facilities such as waste treatment plants, delivering a finished product such as an acceptable waste form for disposal. The companies would have greater latitude in selecting the technology for use in producing the product, than if DOE and its site contractor were managing the design, construction, and operation. The Office of Science and Technology is considering how this new contracting concept would affect their plans for technology development. For example, this type of contracting, to be successful, requires well-defined performance specifications. According to managers in the Office of Science and Technology, they plan to help sites to define do-able performance specifications.

The Office of Science and Technology has begun to draft strategies for supporting these initiatives. For example, the strategies are expected to address how the office can support privatization by sharpening contract specifications and enabling site personnel to determine the acceptability of finished products. After the draft national summary of the sites' 10-year plans is available (expected in late spring of 1997), the Office of Science and Technology plans to obtain public comment on its strategies during the summer of 1997 and then to finalize the strategies. Program managers are aware of the issues that we have just mentioned and recognize that changes in the Office of Science and

Technology may be needed to support EM's new initiatives.

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Mr. Chairman, this concludes my prepared remarks. We would be pleased to respond to any questions that you or Members of the Subcommittee may have.

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